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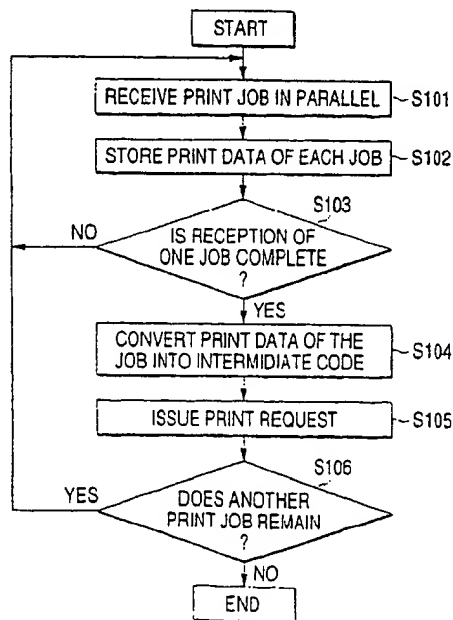
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(54) **Printer**

(57) A printer comprises a print data reception section for receiving print data corresponding to a plurality of print jobs, an intermediate data generation section for generating intermediate code from the received print data, a print request preparation section for issuing a print request for generated intermediate code, and a print

mechanism for printing based on the corresponding intermediate code in the acceptance order of the print requests. The printer is provided with a priority determination section for determining priorities for issuing the print requests so that print requests are issued in the print data transfer termination order, for example.

FIG. 3



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a printer for printing a plurality of print data pieces in a predetermined order.

2. Description of the Related Art

Conventional printers normally are used by local connection to data processing systems in a one-to-one correspondence with each other. Thus, generally printers comprise only a single type of connection interface adaptive to the data processing system to be connected to the printer.

However, with change in an information processing environment in recent years, it has been demanded that a printer can cover data processing systems having different types of interfaces. For example, a printer comprising a number of input interfaces such as serial ports and parallel ports, which will be hereinafter called input ports, is provided in response to such a demand.

Fig. 27 shows an example of such a printer having a number of input ports. In the figure, for example, a printer 30 is connected to four data processing systems, hereinafter called hosts, H (H1-H4) via input ports P (P1-P4), and each input port P (P1-P4) is provided with a buffer memory B (B1-B4) having a predetermined capacity.

In the configuration, assume that print commands and data, which will be hereinafter called print jobs, are input to the input ports P from the hosts H at timings as shown in Fig. 28 and are stored in the buffer memories B. At this time, the printer 30 first prints based on the print job input from the host H1 and subsequently prints based on the print jobs input from the hosts H3, H2, and H4 in order. The reason why the conventional printer 30 prints in the above order is that as shown in Fig. 28, an image formation process is executed in the printer data transfer start order to the input ports P, so that a print request is issued to a print mechanism (not shown), and that at the termination of the print job, an image formation process based on the next received print job is executed.

Thus, the conventional printer 30 starts printing in the print job reception order and does not start printing based on another print job unless the current print job is complete. Therefore, the printer involves the following problem:

In the example shown in Fig. 28, the print jobs sent from the hosts H2-H4 enter a printable state earlier than the print job input from the host H1, but enter a wait state until completion of the print job input from the host H1 because they are late for the print data transfer start time. Thus, an appreciable wait time is contained by the time all print jobs are completed, not only prolonging the

total print time in the printer 30, but also making the operator of the host in the wait state irritated.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide a printer that can solve the problems and execute a plurality of print jobs in the optimum order.

According to a first aspect of the invention, there is provided a printer comprising: means for receiving print data corresponding to a plurality of print jobs; means for generating intermediate code from the print data received by the reception means; print request preparation means for issuing a print request for the generated intermediate code; a print mechanism for printing based on the corresponding intermediate code in an acceptance order of the print requests issued by the print request preparation means; and priority determination means for determining a print job execution priority used as a trigger for issuing the print request.

According to a second aspect of the invention, there is provided a printer comprising: means for receiving print data corresponding to a plurality of print jobs; means for storing a plurality of print data received by the reception means; means for generating intermediate code from each of the print data; means for storing intermediate code generated for each print data; print request preparation means for issuing a print request for the generated intermediate code; a print mechanism for printing based on the corresponding intermediate code in an acceptance order of the print requests issued by the print request preparation means; and priority determination means for determining a print job execution priority used as a trigger for issuing the print request; wherein the priority determination means can select either of first and second priority modes, the first priority mode assigning high execution priorities to print jobs in a storage completion time order of the print data in the print data storage means so that the print requests are issued according to the execution priorities, and the second priority mode assigning high execution priorities to print jobs in a storage completion time order of the intermediate code in the intermediate code storage means so that the print requests are issued according to the execution priorities.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

Fig. 1 is a functional block diagram of a printer according to a first embodiment of the invention;

Fig. 2 is a timing chart to explain the print job processing order in the first embodiment of the invention;

Fig. 3 is a flowchart to show a print procedure according to the first embodiment of the invention;

Fig. 4 is a functional block diagram of a printer ac-

according to a second embodiment of the invention;
Fig. 5 is a timing chart to explain the print job processing order in the second embodiment of the invention;

Fig. 6 is a flowchart to show a print procedure according to the second embodiment of the invention;
Fig. 7 is a functional block diagram of the main part of a printer according to a third embodiment of the invention;

Fig. 8 is a functional block diagram of the main part to show an application example of the printer according to the third embodiment of the invention;

Fig. 9 is a timing chart to explain the print job processing order in the third embodiment of the invention;

Fig. 10 is a functional block diagram of the main part of a printer according to a fourth embodiment of the invention;

Fig. 11 is a schematic block diagram of a print data reception section according to a fifth embodiment of the invention;

Fig. 12 is a flowchart to explain a print data reception process procedure according to each embodiment of the invention;

Fig. 13 is a flowchart to explain an intermediate code generation process procedure from print data according to each embodiment of the invention;

Fig. 14 is flowchart to show a process of a print data reception task;

Fig. 15 is flowchart to show a process of an intermediate code generation task;

Figs. 16(A) and 16(B) show a process of a priority determination task, Fig. 16(A) is a flowchart and Fig. 16(B) is an illustration to show an example of the structure of a priority determination storage section;

Fig. 17 is a flowchart to show a detection process of a data transfer termination detection section;

Fig. 18 is a flowchart to show a detection process of a data storage completion detection section;

Fig. 19 is a flowchart to show a detection process of a data transfer start detection section;

Fig. 20 is a flowchart to show a detection process of a data storage start detection section;

Fig. 21 is a flowchart to show a process of a print request preparation task;

Fig. 22 is a flowchart to show a process of a print request preparation task (continued);

Fig. 23 is a flowchart to show a print mechanism acquisition request subroutine;

Fig. 24 is a flowchart to show an output tray acquisition request subroutine;

Fig. 25 is a timing chart to show an example of whole processing of the tasks;

Fig. 26 is a flowchart to show another process of the print mechanism acquisition request subroutine;

Fig. 27 is a schematic block diagram of a reception section of a conventional printer; and

Fig. 28 is a timing chart to explain the print job processing order in the conventional printer in Fig. 27.

5 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the accompanying drawings, there are shown preferred embodiments of the invention.

10 1st Embodiment

Fig. 1 is a functional block diagram of a printer according to a first embodiment of the invention. As shown here, the printer 1 according to the first embodiment comprises a print data reception section 2, a print data storage section 2a functioning like the above-described buffer memories B, an intermediate code generation section 3, a print request preparation section 4, a priority determination section 51, and a print mechanism 6. The priority determination section 51 comprises a data transfer termination detection section 5a for detecting the transfer termination time of print data of each print job and setting order information in the print jobs in the transfer termination detection order and a priority storage section 5m for storing the transfer termination detection order detected by the data transfer termination detection section 5a. The print data transfer termination time can be detected, for example, by detecting a given blank time at the storage time or specific data such as a transfer end command contained in the print job or by prediction based on the print data size, the processing speed measurement value, etc.

The print data reception section 2, the intermediate code generation section 3, the print request preparation section 4, and the priority determination section 51 are formed in a controller comprising a microprocessor (central processing unit (CPU)) that can perform concurrent processing in a timesharing manner and are given a required function or are controlled by the CPU. The intermediate code generation section 3 is followed by real image data generation section (not shown) for generating a bit image (real image data) of a real image.

The print data reception section 2 receives print jobs (containing print data) sent from hosts H (H1-H4) and has four input ports provided in a one-to-one correspondence with the interfaces of the hosts H. Areas for storing print jobs for each input port are formed in the print data storage section 2a. The print data storage areas are formed in a one-to-one correspondence with the input ports for convenience of the subsequent processing; this manner need not always be adopted and a specific storage area of the print data storage section 2a may be shared among the input ports.

When a predetermined image formation process is executed according to a print job, the intermediate code generation section 3 once converts print data of the print job into intermediate code. The intermediate code is

made up of position information for each print data piece and image information at the position (bit map data for characters, form data for graphics, or image data for photos, etc.). The reason why print data is converted into intermediate data is that if real image data is generated directly from print data, the image formation process becomes complicated and takes time and that normally the intermediate code size is smaller than the real image data size at the storage time. The generated intermediate code is developed or compressed into the real image data whenever necessary by the real image data generation means and is stored until an instruction is given from the print mechanism 6.

The print request preparation section 4 prepares a print request for the intermediate code generated by the intermediate code generation section 3 and issues the print request to the print mechanism 6 according to order information from the priority determination section 51.

The print mechanism 6, which has an engine (not shown), gets real image data corresponding to the intermediate code in the acceptance order of the print requests issued by the print request preparation section 4 and executes printing on paper.

Next, an operation example of the printer 1 in the embodiment will be discussed with reference to Figs. 2 and 3. Fig. 2 is a timing chart to explain print request issuing priorities (print job execution priorities). Here, for convenience, the print data transfer timings from the hosts H1-H4 are made the same as those in the example in Fig. 28. Fig. 3 is a flowchart to show a print procedure according to the embodiment.

Print jobs (containing print data) from the hosts H1-H4 are transferred to the corresponding input ports of the print data reception section 2. As shown in Fig. 3, the print data reception section 2 receives the transferred print jobs in parallel at step S101 and stores the print data in the print data storage section 2a in order at step S102. When reception of one job is complete, namely, when transfer of print data is complete at step S103, the intermediate code generation section 3 converts the print data of the job into intermediate code at step S104. At this time, the priority determination section 51 detects a job whose print data has been transferred by the data transfer termination detection section 5a, determines the print request issuing order of the job, stores the order in the priority storage section 5m, and sends the order to the print request preparation section 4, which then issues a print request according to the order at step S105. This process is repeated in order for other print jobs whose print data has been transferred. When no print data remains at step S106, the processing is terminated.

Thus, in the embodiment, a print request is issued in the print data transfer termination order of the print jobs and printing on paper is executed. In the example in Fig. 2, the transfer start time of the print data from the host H1 to the print data storage section 2a is the earliest, but the transfer completion of the print data is the latest

because the print data has a large size or the data transfer speed of the print data is slow. Therefore, the print job is assigned priority (4). In contrast, the transfer start time of the print data from the host H2 is the third, but the transfer completion of the print data is the earliest. Therefore, the print job is assigned priority (1), the highest priority. Likewise, the print job from the host H3 is assigned priority (2) and the print job from the host H4 is assigned priority (3). Then, the print request preparation section 4 issues print requests in the order of the print jobs from the hosts H2, H3, H4, and H1, and the print mechanism 6 executes printing.

Thus, in the embodiment, intermediate code generation of the print data of the print job whose print data has been transferred, such as the print job from the host H2, and printing based on the print job are executed earlier, and the print jobs and print data from other hosts H1, H3, and H4 are stored in the print data storage section 2a and intermediate code generation and printing are executed later. Upon completion of the preceding printing, printing based on the next print job is executed successively. Therefore, the use efficiency of the engine in the print mechanism 6 is raised and sharing the printer 1 matching user's feeling of reality is enabled.

2nd Embodiment

Fig. 4 is a functional block diagram of a printer 20 according to a second embodiment of the invention. Parts identical with those of the printer 1 of the first embodiment previously described with reference to Fig. 1 are denoted by the same reference numerals in Fig. 4. The printer 20 in the second embodiment has an intermediate code storage section 3a comprising RAM, etc., added to the intermediate code generation section 3 in Fig. 1 for storing intermediate code generated based on print data. It is provided with a data storage completion detection section 5b for detecting the storage completion time of the intermediate code storage section 3a and a priority storage section 5m for storing the storage completion time detected by the data storage completion detection section 5b, the sections 5b and 5m making up a priority determination section 52.

The data storage completion time can be detected, for example, by detecting a given processing blank time while the intermediate code generation section 3 generates and stores intermediate code or by predicting the storage completion time of intermediate code from the intermediate code generation speed and the data size of the intermediate code and the time required for storing the intermediate code after generation of the intermediate code, etc. The intermediate code storage completion time needs to be predicted also considering the fact that the time required for generating the intermediate code varies depending on complicity of print data and the fact that previous development for developing into real image data rather than intermediate code and compressing is performed as required.

In the embodiment, the priority determination section 52 assigns high execution priorities to print jobs in the completion time order of storing real image data in the intermediate code storage section 3a and stores the print job execution priorities in the priority storage section 5m, so that a print request preparation section 4 issues print requests in the execution priority order, provided that a print data storage section 2a and the intermediate code storage section 3a can have a sufficient memory capacity.

Fig. 5 is a timing chart to explain print request issuing priorities (print job execution priorities). Fig. 6 is a flowchart to show a print procedure according to the embodiment.

In Fig. 6, print jobs (containing print data) from hosts H1-H4 are received in parallel and the print data is stored in the print data storage section 2a at steps S201 and S202, as in the first embodiment. However, the print data is temporarily stored in the print data storage section 2a for intermediate code generation at the following stage.

In the embodiment, as shown in Fig. 6, intermediate code of print data based on each job is generated in parallel at step S203 and the generated intermediate code is stored in the corresponding area of the intermediate code storage section 3a at step S204. When intermediate code generation for one job terminates, namely, when intermediate code storage is complete at step S205, the priority determination section 52 determines the print request issuing order and sends the order to the print request preparation section 4, which then issues a print request according to the order at step S206. This process is repeated in order for other print jobs whose intermediate code has been stored. When no print data remains at step S207, the processing is terminated.

According to the procedure, print requests are issued in the storage completion order of intermediate code in the intermediate code storage section 3a regardless of the transfer start or termination time of print data, and printing on paper is executed. In the example in Fig. 5, intermediate code storage is complete the earliest for the print job from the host H3. Therefore, the print job is assigned the highest priority (1). Likewise, the print jobs from the hosts H2, H4, and H1 are assigned priorities (2), (3), and (4) respectively. Then, the print request preparation section 4 issues print requests in the order of the print jobs from the hosts H3, H2, H4, and H1, and a print mechanism 6 executes printing.

Thus, if the print data storage section 2a and the intermediate code storage section 3a can have a sufficient memory capacity, the use efficiency of the engine in the print mechanism 6 can be enhanced as compared with the first embodiment and the printer 20 more matching user's feeling of reality can be configured.

3rd Embodiment

Fig. 7 is a functional block diagram of the main part of a printer according to a third embodiment of the invention.

In the embodiment, a priority determination section 53 is made up of the above-described data transfer termination detection section 5a, data storage completion detection section 5b, and priority storage section 5m, and a data transfer start detection section 5c for detecting the transfer start time of print data and a mode selection section 5d for selecting any of the detection results of the detection sections 5a-5c as a priority determination criterion. Other components of the printer are the same as those of the printer 1 of the first embodiment.

In the third embodiment, the mode selection section 5d enables selection of one of a first priority mode for assigning high execution priorities to print jobs in the print data transfer termination order, a second priority mode for assigning high execution priorities to print jobs in the intermediate code storage completion order in an intermediate code storage section 3a, and a third priority mode for assigning high execution priorities to print jobs in the print data transfer start order. Mode selection of the mode selection section 5d can be executed in response to a user command, for example.

As an application example, a priority determination section 54 can also be provided with a memory capacity detection section 5e and an automatic mode switch section 5f in addition to the components of the priority determination section 53 for automatically selecting one of the modes, as shown in Fig. 8.

In Fig. 8, the memory capacity detection section 5e detects an available memory capacity in a print data storage section 2a and an intermediate code storage section 3a, and the automatic mode switch section 5f controls the mode selection section 5d based on the detection value for automatically switching the mode among the first to third priority modes.

An operation example of the printer according to the embodiment will be discussed with reference to Fig. 9.

If each storage section can have a sufficient available memory capacity provided as a result of detection of the memory capacity detection section 5e, the automatic mode switch section 5f causes the mode selection section 5d to select the second priority mode. At this time, print jobs from hosts H1-H4 are not made to wait in the state of print data being stored (A) and real image data is generated and stored (B) in parallel, as described in the second embodiment. Print requests are issued in the intermediate code storage completion order for executing printing.

On the other hand, for example, if the intermediate code storage section 3a has an available memory capacity equal to or less than a predetermined threshold value although the print data storage section 2a has a sufficient available memory capacity, the automatic

mode switch section 5f causes the mode selection section 5d to select the first priority mode. At this time, for the print jobs from the hosts H1-H4, print data is received and stored (A) in parallel, but intermediate code is generated and stored (B) and print requests are issued in the print data transfer termination order. If the print data storage section 2a has an available memory capacity equal to or less than a predetermined threshold value, the third priority mode is selected and for the print jobs from the hosts H1-H4, intermediate code is generated and stored (B) and print requests are issued in the print data transfer start order as with the conventional printer. Then, the optimum priority determination for the current printer state is enabled.

4th Embodiment

Fig. 10 is a functional block diagram of the main part of a printer according to a fourth embodiment of the invention.

In the embodiment, a priority determination section 55 is made up of the above-described data transfer termination detection section 5a, data storage completion detection section 5b, and data transfer start detection section 5c, and a data storage start detection section 5g for detecting the storage start time of intermediate code of print data, a mode selection section 5d for selecting any of the detection results of the detection sections 5a-5c and 5g as a priority determination criterion, and a priority storage section 5m for storing the priority determined based on the detection result of the detection section selected by the mode selection section 5d. Other components of the printer are the same as those of the printer 1 of the first embodiment.

In the fourth embodiment, the mode selection section 5d enables selection of one of a first priority mode for assigning high execution priorities to print jobs in the print data transfer termination order, a second priority mode for assigning high execution priorities to print jobs in the intermediate code storage completion order in an intermediate code storage section 3a, a third priority mode for assigning high execution priorities to print jobs in the print data transfer start order, and a fourth priority mode for assigning high execution priorities to print jobs in the storage start time order of the intermediate code in the intermediate code storage section 3a. Mode selection of the mode selection section 5d can be executed in response to a user command, for example.

An automatic mode switch section can also be provided for automatically switching the mode among the first to fourth priority modes as in the application example of the third embodiment described above.

5th Embodiment

The description of the first to fourth embodiments assumes that the print data reception section 2 has a plurality of input ports provided in a one-to-one corre-

spondence with the hosts H1-H4. However, for example, as shown in Fig. 11, print jobs from hosts H1-Hn and print data accompanying the print jobs can also be received by one network port 2b and the above-described CPU in parallel. That is, while data is being received from one host, if data is received from another host, the print data is received by the current reception program being executed in parallel while the CPU is time-shared, whereby processing can be performed as if a plurality of input ports were provided.

Fig. 12 shows an example of a parallel reception procedure of print jobs from the hosts H1-H4 connected to a plurality of input ports or the hosts H1-Hn connected to the network port 2b and the print data accompanying the print jobs, as described in the first to fifth embodiments.

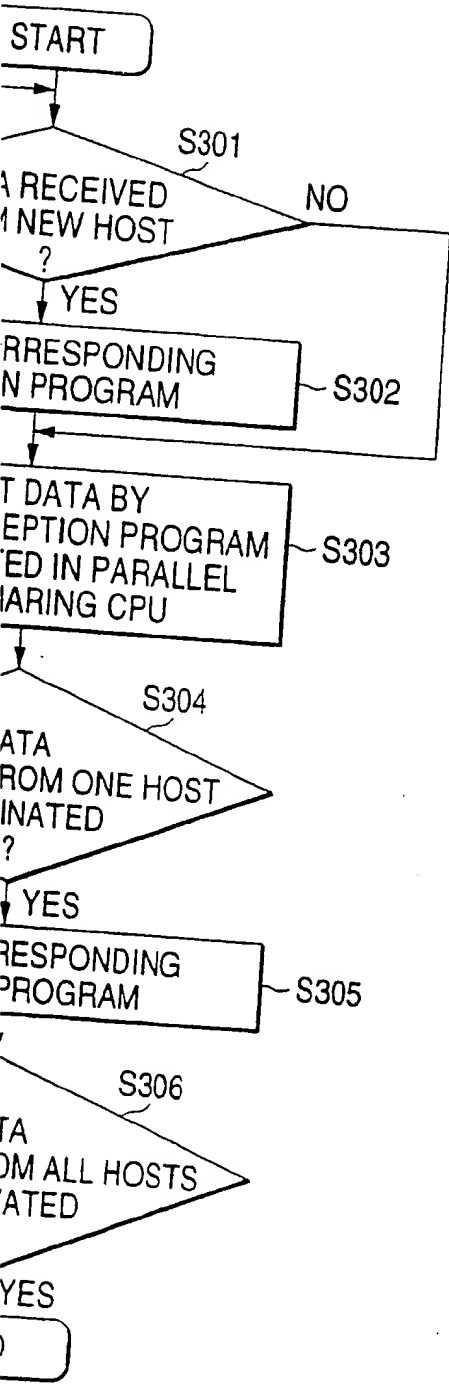
In Fig. 12, while data is being received from one host, if data is received from another host, namely, if a request for receiving a print job and its accompanying print data is received at step S301, the print data reception section 2 starts the corresponding reception program at step S302 and receives the print data by the current reception program being executed in parallel while time-sharing the CPU at step S303. The received print data is stored in the corresponding area of the print data storage section 2a in sequence. If data reception from one host is terminated at step S304, the print data reception section 2 stops and stores the corresponding reception program at step S305. The steps are executed for all hosts and when data reception from all hosts terminates at step S306, the data reception process is terminated.

Fig. 13 shows an example of a procedure of the intermediate code generation section 3 for converting print data received from the hosts and stored in the corresponding areas of the print data storage section 2a in sequence into intermediate code in parallel, as described in the first to fifth embodiments.

In Fig. 13, while one print data piece is being converted into intermediate code, if another print data piece is stored, namely, if a request for converting print data into intermediate code is made at step S401, the intermediate code generation section 3 starts the corresponding intermediate code generation program at step S402 and converts the print data into intermediate code by the current intermediate code generation program being executed in parallel while time-sharing the CPU at step S403. If conversion of one print data piece into intermediate code terminates at step S404, the intermediate code generation section 3 stores the corresponding intermediate code generation program at step S405. The steps are executed for all print data and when conversion of all print data into intermediate code is terminated at step S406, the intermediate code generation process is terminated.

Starting the corresponding program at step S302, S402, storing the corresponding program at step S304, S405 in the parallel data reception processing or the

FIG. 12



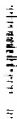


FIG. 14

(PRINT DATA RECEPTION TASK 1)

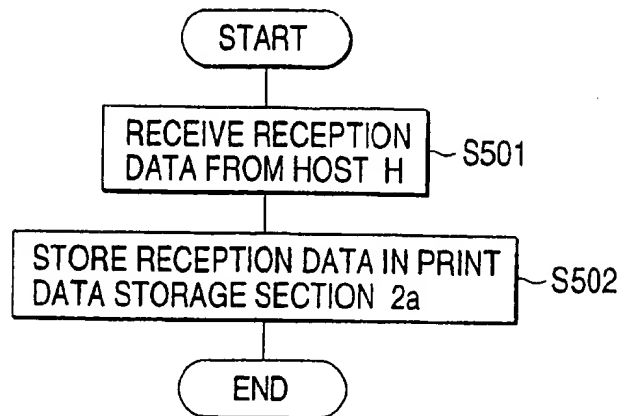


FIG. 15

(INTERMEDIATE CODE GENERATION TASK 1)

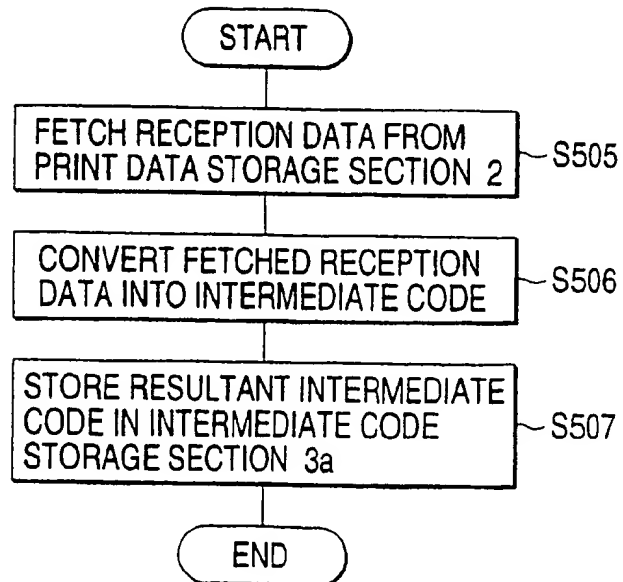


FIG. 16 (A)

(PRIORITY DETERMINATION TASK)

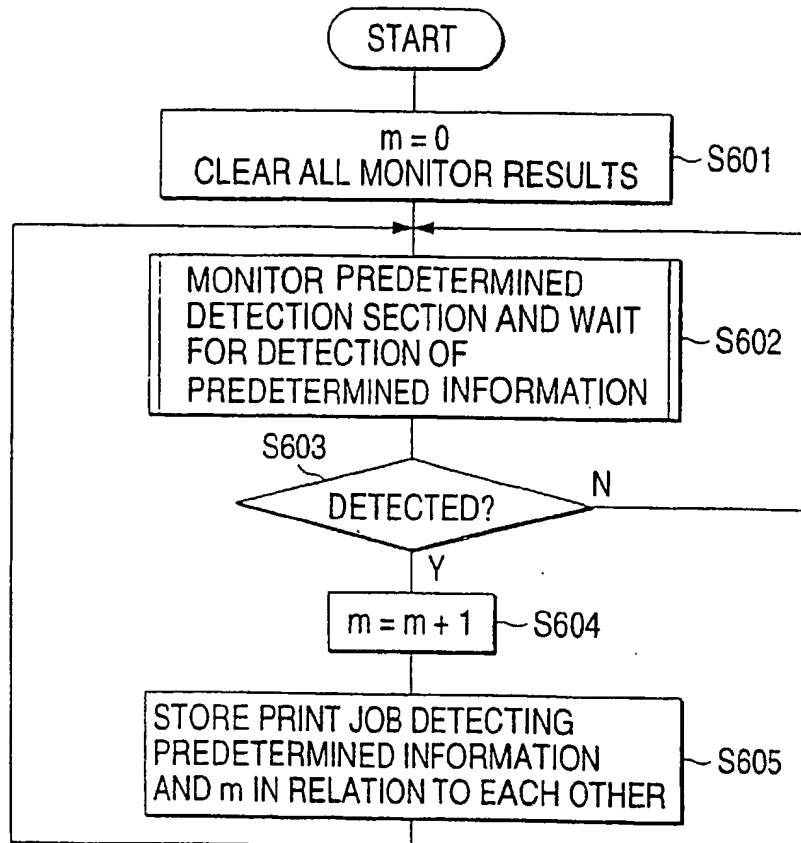


FIG. 16 (B)

PRINT JOB NO.	1	2	3
m	2	1	3

FIG. 17

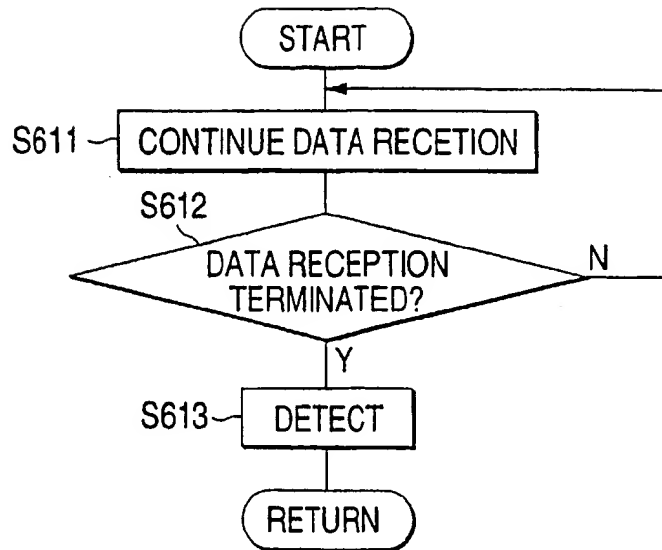


FIG. 18

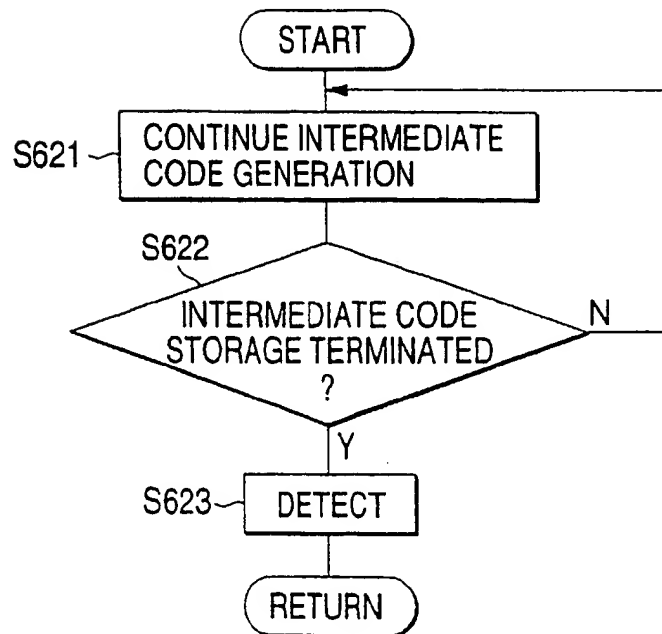


FIG. 26

PRINT MECHANISM ACQUISITION REQUEST SUBROUTINE

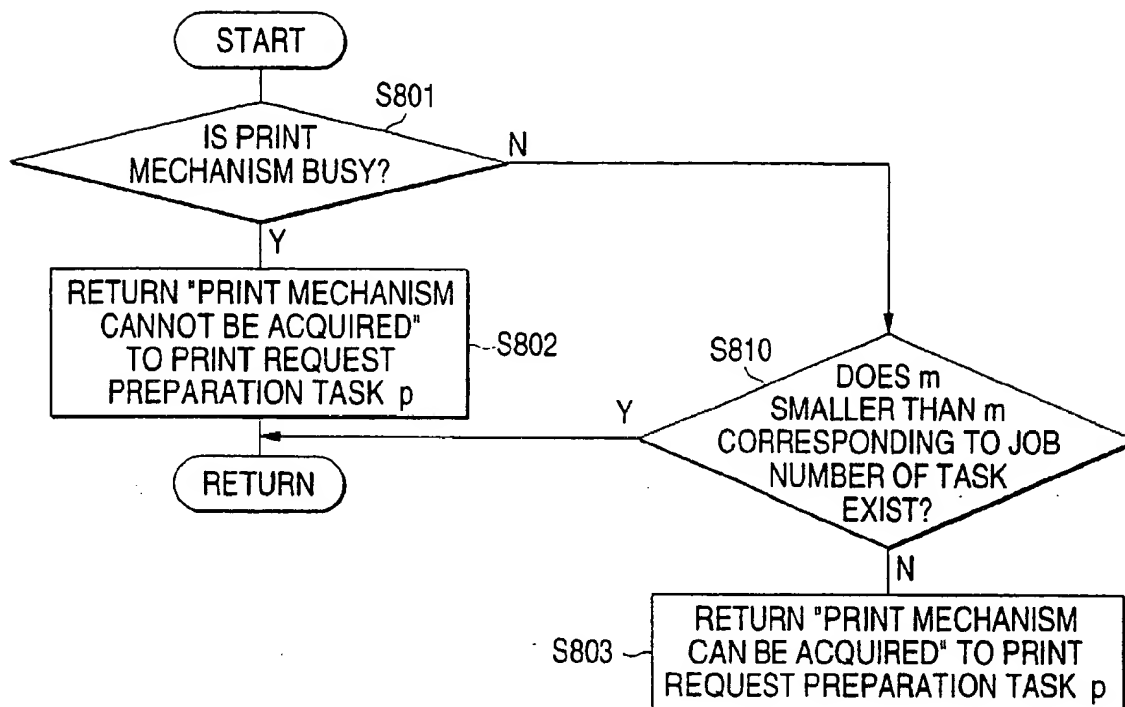
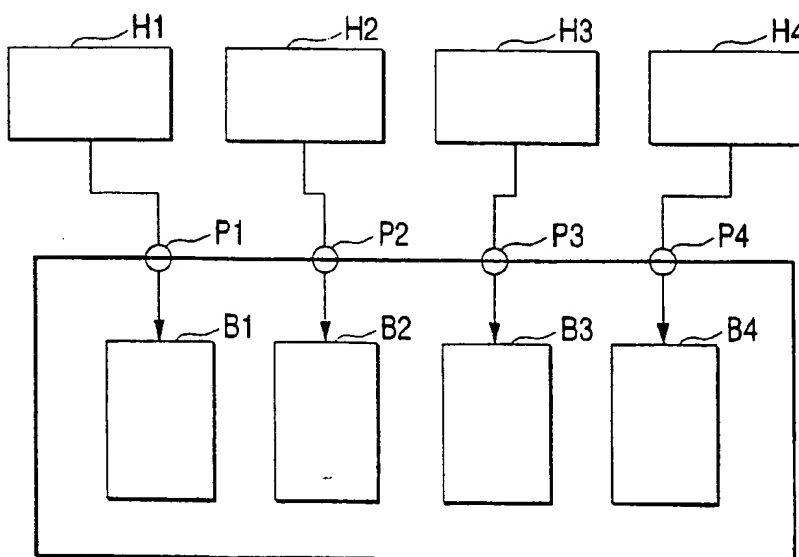
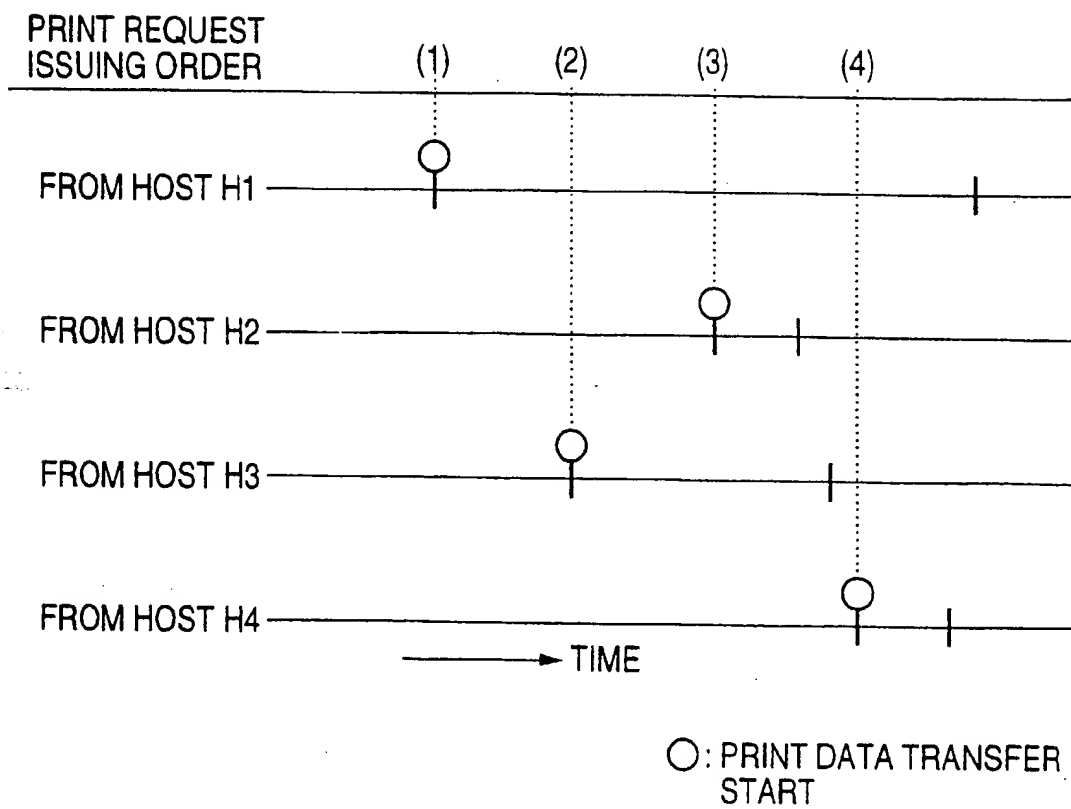
FIG. 27
RELATED ART

FIG. 28

RELATED ART



(19)



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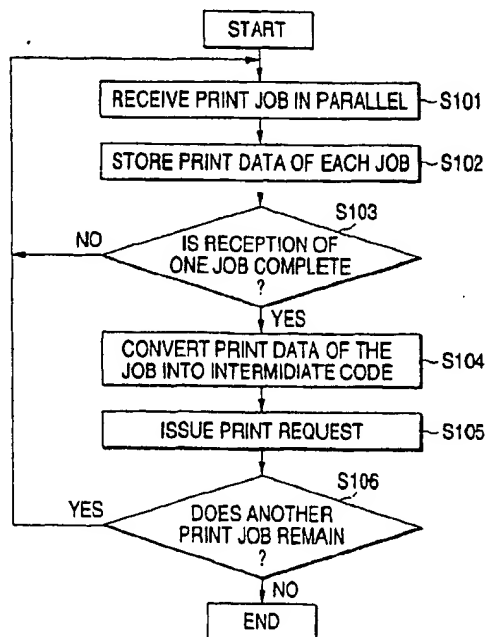
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(54) Printer

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FIG. 3



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European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 4344

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (InCL1.6)
X	EP 0 653 700 A (FUJITSU LTD) 17 May 1995 (1995-05-17)	1,2,4	G06K15/00 G06F3/12
A	* column 11, line 27 - column 12, line 25; figures 5,12 *	5	
A	* column 15, line 50 - column 17, line 15 *		
A	US 5 327 526 A (FUJITA YUZO ET AL) 5 July 1994 (1994-07-05) * the whole document *	5	
			TECHNICAL FIELDS SEARCHED (InCL1.6)
			G06F
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 20 December 2000	Examiner Cardigos dos Reis, F
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EP 97 30 4344

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